BASTERIA, 71: 209-220, 2007

Bukit Sarang (Sarawak, Malaysia), an isolated limestone hill with an extraordinary snail fauna

J. J. VERMEULEN
Nationaal Herbarium, Leiden Branch, P.O. Box 9514, NL 2300 RA Leiden, The Netherlands

& D. J. JUNAU
Grand Perfect Sdn Bhd, Lot 3469 & 3470, Parkcity Commerce Square, Jln Tun Ahmad Zaidin, 97008 Bintulu, Sarawak, Malaysia

Bukit Sarang is an isolated limestone hill in the Tatau River basin, Sarawak, Malaysia (on the island of Borneo). Out of the 83 land snail species found, 26 are assumed to be endemic to the hill. Nine of these are described as new in this paper; they belong to the Assimineidae (*Acmella*: 3 species), Cyclophoridae (*Japonia*: 2 species; *Opisthoporus*: 1 species), Hydrocenidae (*Georissa*: 1 species), Camaenidae (*Amphidromus*: 1 species), Charopidae (*Teracharopa*: 1 species).

Key words: Gastropoda, Caenogastropoda, Pulmonata, Assimineidae, Cyclophoridae, Hydrocenidae, Camaenidae, Charopidae, taxonomy, Malaysia, Borneo.

INTRODUCTION

Limestone hills (karst) are widespread in Sarawak (Malaysia, part of the island of Borneo), but not equally distributed over the state. Extensive karst is found in the West, between Bau and Serian. In the East, scattered areas occur, such as those in Gunung Mulu National Park, Niah Caves National Park, and in the Baram River headwaters. In between East and West Sarawak karst areas are few and far apart. They are restricted to the Tatau River basin: Bukit Sarang downstream, the Ulu Kakus range upstream. Both limestone outcrops are extremely isolated: the distance between the two outcrops is about 60 km, the nearest limestone ranges to the SW., NE. and SSE. (in adjacent Kalimantan, Indonesia) of Bukit Sarang are about 325 km, 150 km and 210 km away, respectively. A few thin, nameless beds of marl and limestone along Arip River and near Tatau, both about 25 km to the W. of Bukit Sarang have been mapped (see Wilford, 1956: 48), these have not yet been investigated.

Bukit Sarang consists in fact of two minute limestone hills of Tertiary age: Bukit Anyi (800 × 300 m), and Bukit Lebik (300 × 150 m, total outcrop surface of the two about 0.3 sqkm). A map is provided by Harrison & Reavis (1966). The hills are situated in an extensive, partly logged swamp area which is notable for its False Gavials, *Tomistoma schlegeli* S. Mueller, 1838 (Crocodilia, Gavialidae). The inaccessibility of the area, as well as protracted tribal conflicts over rights to harvest bird's nests from the caves, kept people from settling near the hills. This explains their relatively pristine state.

The first snail collecting on Bukit Sarang was done in 1962, by M. Bong, as an aside to geological exploration. The soil sample contained no fewer than 12 endemic mollusc species (Dance, 1970; Vermeulen, 1993, 1994), which marked the local fauna as of exteme interest. Nevertheless, it was only in 2005 that the present authors could undertake a more thorough survey. All collecting was done by taking soil samples on a large scale, augmented with hand-picked specimens of the medium-sized and larger species.

Altogether, the samples included 83 species of land molluscs. Earlier collecting elsewhere in Sarawak enabled us to identify species that are likely to be endemic to Bukit

Sarang. We found 26 likely endemics or 31% of the local snail fauna. This is very high. Usually, small limestone outcrops the size of Bukit Sarang (0.3 sqkm) are home to only a few endemics. For example, isolated limestone outcrops in the Sangkulirang Peninsula, have 6-11% endemics among faunas of 30 to 100 species (Vermeulen, 2005). Bukit Sarang scores close to percentages usually found, on Borneo, for much larger limestone areas. For instance, surveys in the Sangkulirang Peninsula (Kalimantan Timur, roughly estimated 2900 sqkm of limestone outcrop), the Bau-Serian limestone ranges (Sarawak, 150 sq km), Gunung Mulu N.P. limestones (Sarawak, 80 sqkm), and Batu Niah N.P. (Sarawak, 9 sq. km) yielded 26 % (of 147 species), 43% (of 148 species), 34% (of 97 species), and 35% (of 108 species) assumedly endemic species respectively (above data from Vermeulen 2003, 2005). On Borneo, Bukit Sarang probably packs the highest number of endemic snail species on the smallest surface of limestone bedrock.

The genus *Bruggennea* Dance, 1972 (Streptaxidae), with three species, is entirely endemic to Bukit Sarang (see Vermeulen, 2007). This is exceptional. On Borneo, *Platycochlium* Laidlaw, 1950 (Steptaxidae), with 3 species, is endemic to the Bau-Serian limestones, and *Niahia* Vermeulen, 1996 (Diplommatinidae), monotypic, to Batu Niah N.P. Both areas, again, are much larger than Bukit Sarang.

An interesting, little studied phenomenon on Borneo limestones is the occurrence of sympatric species couples that look very similar. *Bruggennea laidlawi* (Dance, 1970) and *B. luminifera* spec. nov. (Streptaxidae) are so similar that they may well be sister species. The same applies to *Japonia hyalina* spec. nov., and *Japonia ditropis* spec. nov., described below. Elsewhere, similar couples occur: in Batu Niah N.P., *Opisthostoma holzmarki* Thompson, 1978, and *O. grandispinosum* Godwin Austen, 1889, live sympatrically with very similar (yet undescribed) species (Vermeulen, 2003).

Because the area has known little inhabitatation, invasive mollusc species that follow mankind in its wake, such as *Achatina fulica* Bowdich, 1822, *Bradybaena similaris* (Férussac, 1821), *Subulina octona* (Bruguière, 1792), have not been able to gain a foothold on the hills (with possible exception of *Lamellaxis clavulinus* (Potier & Michaud, 1838). The smaller streams in the swamp, particularly those near the limestone hills, are still home to large colonies of the freshwater mussel *Rectidens lingulatus* (Drouet & Chaper, 1892) (Unionidae). Borneo Unionidae are severely threatened by the combined effects of logging (silting up of rivers), pollution and collecting for food. Luckily, settlement near the hills is still not allowed, and the hills are well-guarded to enforce a sustainable exploitation of the bird's nests. The regular patrols of the guards and the general inaccessibility make Bukit Sarang and its unique biodiversity comparatively well-protected, though always vulnerable because of its small size.

Below, nine new, endemic species are described for Bt. Sarang. More new endemics have been identified, but a closer investigation is needed before these, too, can be formally described.

References to material present in the collection of the first author are abbreviated as 'V', followed by a collection number. The pencil drawings have been made by the first author, with the aid of a Wild M8 stereo microscope with a camera lucida device. Holotypes will be deposited in the Nationaal Natuurhistorisch Museum, Leiden (RMNH).

SYSTEMATIC PART

Family Assimineidae H. & A. Adams, 1856

Acmella Blanford, 1869

Notes. – *Acmella* species are common in soil samples from Bornean limestone areas. About 15 species have been identified. All but two are endemic to the island, and the two widespread ones are the only named so far: *Acmella polita* Von Moellendorff, 1887, and *A. minutissima* (Maassen, 2000).

Next to the three species described below, a fourth one occurs on Bukit Sarang. It is distinctive, with a conical spire and a cancellate sculpture, but the material available is too poor to allow formal description.

Acmella caelata spec. nov. (fig. 1)

Material seen. – Malaysia, Sarawak, 2nd div.: Lower Tatau River valley, Bukit Sarang group (leg. Serena Lee, V 12641/1 paratype, RMNH 109078/holotype).

Shell. – Shell minute, conical-ovoid with about flat sides and a broadly rounded apex, slightly translucent white, somewhat shiny. Whorls 3 1/8-3 3/8, moderately convex. Suture impressed. Protoconch about smooth at 40 × magnification. Radial sculpture teleoconch: growth lines only, locally more distinct than elsewhere. Spiral sculpture teleoconch: fine, densely placed, flat spiral threads with shallow, narrow grooves in between. Umbilicus open, narrow. Aperture somewhat obliquely ovate, narrowly rounded above, well rounded below, transition from parietal to columellar side gradual. Peristome simple, reflected on the columellar side, not so on the palatal side. Height 0.80-0.95 mm; width c. 0.7 mm. Apertural height c. 0.40 mm, width 0.32-0.35 mm.

Ecology. – Lowland rainforest on and near limestone bedrock.

Distribution. – Malaysia, Sarawak, 2nd div.: Tatau River Basin, Bukit Sarang.

Notes. – *Acmella minutissima* (Maassen, 2000), from Sumatra and Borneo, is wider (0.8-1 mm wide), has a finer spiral sculpture, and an aperture with a more angular transition from the parietal to the columellar side. An undescribed species from Sabah looks very similar in most aspects, but has a more compressed spire (shell height 0.65-0.75 mm, with 3 1/2-3 7/8 whorls). Differs from *A. conica* and *A. obtusa*, below, in having a broadly rounded apex and an ovate aperture.

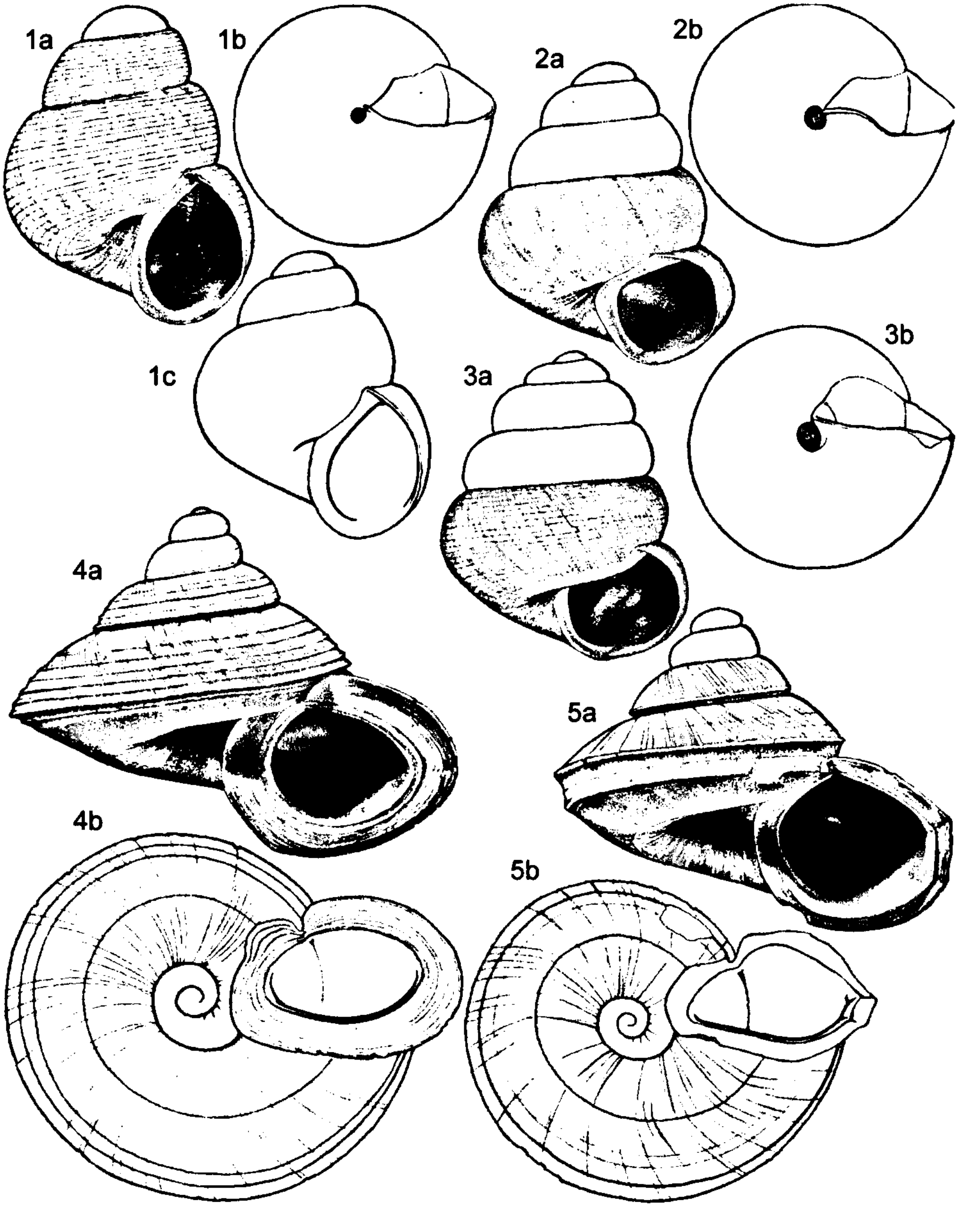
Acmella conica spec. nov. (fig. 2)

Material seen. – Malaysia, Sarawak, 2nd div.: Lower Tatau River valley, Bukit Sarang group (leg. Serena Lee, V 12639/1 paratype, RMNH 109079/holotype).

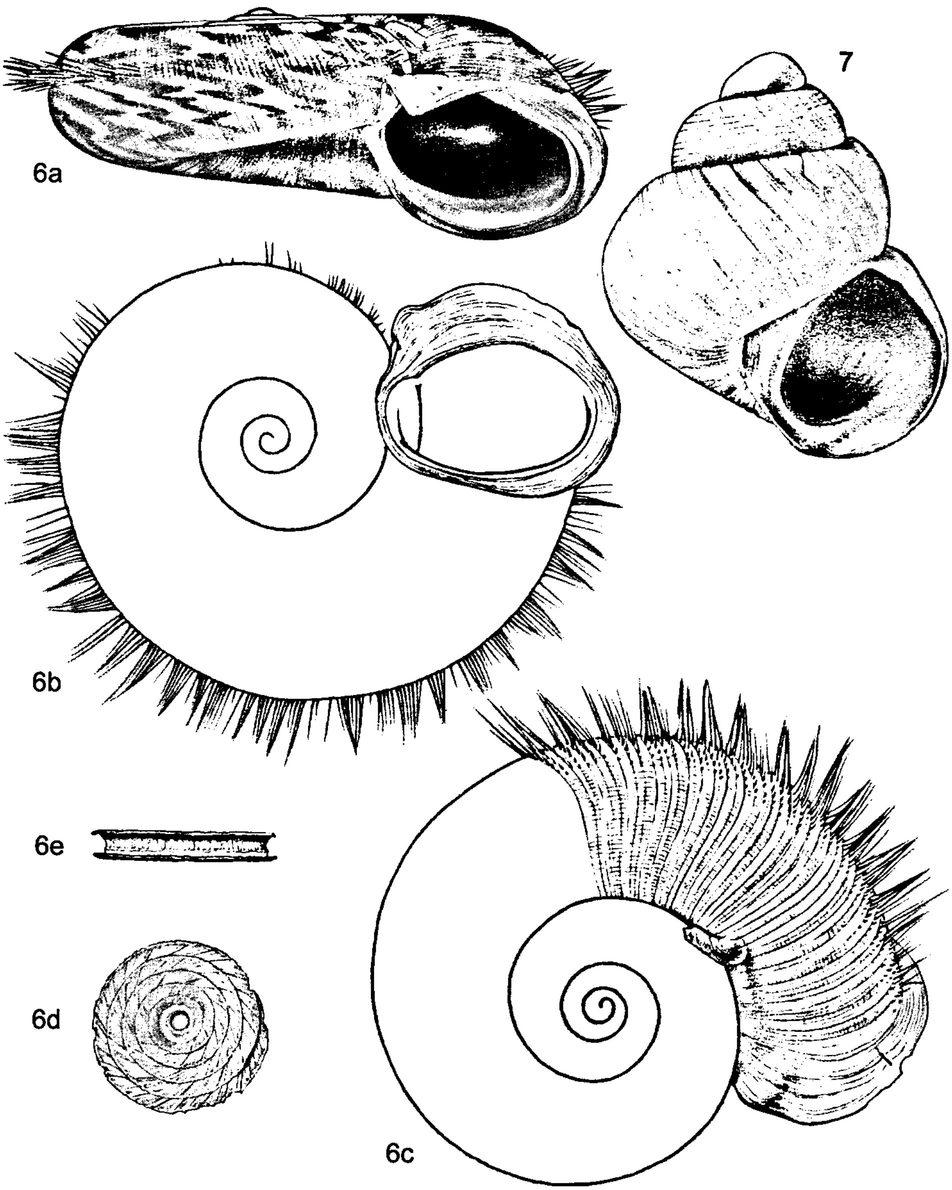
Shell. – Shell minute, conical with about flat sides and a rounded apex, slightly translucent white, somewhat shiny. Whorls 4-4 1/8, convex. Suture impressed. Protoconch about smooth at 40 x magn. Radial sculpture teleoconch: inconspicous growth lines only. Spiral sculpture teleoconch: locally traces of a very fine, dense spiral striation, only just visible at 40 times magn. Umbilicus open, narrow. Aperture about elliptic with a flattened parietal side, rounded above, broadly rounded below, transition from parietal to columellar side somewhat angular. Peristome simple, reflected on the columellar side, not so on the palatal side. Height c. 0.85 mm; width 0.70-0.75 mm. Apertural height 0.25-0.30 mm, width 0.30-0.35 mm.

Ecology. – Lowland rainforest on and near limestone bedrock.

Distribution. – Malaysia, Sarawak, 2nd div.: Tatau River Basin, Bukit Sarang.



Figs 1-5. *Acmella* and *Japonia* spec. **1. a**, *Acmella caelata* spec. nov., holotype, Malaysia, Sarawak, Bukit Sarang (RMNH, shell height 0.95 mm), frontal view; **b**, do., umbilical view; **c**, do., paratype specimen from same locality (V, shell height 0.8 mm), frontal view of aperture. **2. a**, *Acmella conica* spec. nov., holotype, Malaysia, Sarawak, Bukit Sarang (RMNH, shell height 0.85 mm), frontal view; **b**, do., umbilical view. **3. a**, *Acmella obtusa* spec. nov., holotype, Malaysia, Sarawak, Bukit Sarang (RMNH, shell height 0.9 mm), frontal view; **b**, do., paratype specimen from same locality (V), umbilical view. **4. a**, *Japonia hyalina* spec. nov., holotype, Malaysia, Sarawak, Bukit Sarang (RMNH, shell height 3.5 mm), frontal view; **b**, do., umbilical view. **5. a**, *Japonia ditropis* spec. nov., holotype, Malaysia, Sarawak, Bukit Sarang (RMNH, shell height 2.8 mm), frontal view; **b**, do., umbilical view.



Figs 6-7. *Opisthoporus* and *Georissa* spec. **6. a**, *Opisthoporus serenae* spec. nov., holotype, Malaysia, Sarawak, Bukit Sarang (RMNH, shell diameter 17.2 mm), frontal view; **b**, do., umbilical view; **c**, do., apical view; **d**, do., operculum, outer surface; **e**, do., operculum, lateral view. **7.** *Georissa pachysoma* spec. nov., holotype, Malaysia, Sarawak, Bukit Sarang (RMNH, shell height 1.7 mm), frontal view.

Acmella obtusa spec. nov. (fig. 3)

Material seen. – Malaysia, Sarawak, 2nd div.: Lower Tatau River valley, Bukit Sarang group, Bukit Anyi, SE. side (V 12760/>10 paratypes, RMNH 109080/holotype).

Shell. – Shell minute, conical with about flat sides and a broadly rounded apex, slightly translucent white, somewhat shiny. Whorls 4 3/8-4 5/8, convex. Suture impressed. Protoconch about smooth at 40 x magn. Radial sculpture teleoconch: inconspicous growth lines only. Spiral sculpture teleoconch: fine, densely placed spiral threads. Umbilicus open, narrow. Aperture about elliptic with a flattened patieral side, rounded above, broadly rounded below, transition from parietal to columellar side somewhat angular. Peristome simple, reflected on the columellar side, not so on the palatal side. Height 0.9-1.0 mm; width 0.70-0.75 mm. Apertural height 0.25-0.30 mm, width 0.30-0.35 mm.

Ecology. – Lowland rainforest on and near limestone bedrock.

Distribution. – Malaysia, Sarawak, 2nd div.: Tatau River Basin, Bukit Sarang.

Notes. – *A. conica*, above, differs in having a somewhat less wide top, a less compressed spire and at most traces of a spiral sculpture.

Family Cyclophoridae Kobelt, 1902

Japonia Gould, 1859

Japonia hyalina spec. nov. (fig. 4)

Material seen. – Malaysia, Sarawak, 2nd div.: Lower Tatau River valley, Bukit Sarang group (leg. Serena Lee, V 12409/4 paratypes); do., Bukit Anyi, NW. side (V 12778/>10 paratypes, RMNH 109081/holotype); do., Bukit Lebik, ground level (V 12779/>10 paratypes).

Shell. – Shell very small, conical with concave sides, translucent white, shiny. Whorls 4 1/8-4 5/8, the first whorls convex, the last distinctly keeled at the periphery, slightly convex above and below. Suture impressed. Sculpture protoconch: surface minutely verrucate. Radial sculpture teleoconch: the first whorls with fine, densely placed and regularly spaced riblets, later whorls with growth lines, only locally grading into riblets. Spiral sculpture teleoconch: the first whorls with 6-9 about equally strong spiral ridges with a minutely erose crest; in the later whorls the lowermost developing into the peripheral keel and above this 2-6 continuing, those closest to the periphery strongest, and leaving the area below the suture withous spiral sculpture; below the periphery with c. 3 spiral ridges: 2 near the periphery and a third, very weak, basal. Umbilicus open, 0.7—0.9 mm diam. Aperture subcircular. Peristome triple; the inner two little reflected, close together, not reflected, a circular rim with a notch at the level of the suture; the outer distinctly widened and reflected, flat or slightly convex, widening towards the palatal side, deeply notched near the suture. Height 2.9-3.5 mm; width (excl. peristome) 3.6-4.4 mm. Apertural height 1-1.2 mm, width 1.1-1.3 mm. Periostracum very thin, translucent, virtually without appendages.

Ecology. – Lowland rainforest on and near limestone bedrock. A leaf litter dweller.

Distribution. – Malaysia,. Sarawak, 2nd div.: Tatau River Basin, Bukit Sarang.

Notes. – Easily recognizable among Bornean *Japonia* because by the following combination of characters: shell small, glassy, white without any brown markings, peripheral keel distinct, periostracum very thin, translucent. The shells resemble *Craspedotropis andrei* Vermeulen, 1999 (Sarawak: Gunung Mulu N.P.) which, however, has a more angular peri-

stome and weaker spiral sculpture above the peripheral keel. In spite of the resemblance, we think that both *Japonia* species presently described are, indeed, *Japonia* ather than *Craspedotropis* because they have a distinct notch in the peristome, near the suture; a character typical for *Japonia* but absent in *Craspedotropis*. The two genera also differ in operculum structure but, onfortunately, no operculums are available of the two species described here.

Japonia ditropis spec. nov. (fig. 5)

Material seen. – Malaysia, Sarawak, 2nd div.: Lower Tatau River valley, Bukit Sarang group, Bukit Anyi, NW. side (V 12780/>10 paratypes); do., Bukit Anyi, SE-side (V 12781/10 paratypes); do., Bukit Lebik, ground level (V 12782/>10 paratypes, RMNH 109082/holotype); do., Bukit Lebik, sediment deposits c. 40 m above ground level (V 12783/3 paratypes).

Shell. – Shell very small, conical with concave sides, slightly translucent pale corneous to white, somewhat shiny. Whorls 3 3/8-4 1/2, the first whorls convex, the last keeled slightly above and below the periphery, slightly convex above and below. Suture impressed. Sculpture protoconch: surface minutely verrucate. Radial sculpture teleoconch: the first whorls with fine, densely placed and regularly spaced riblets, later whorls with growth lines, partly and sometimes at more or less regular intervals grading into riblets. Spiral sculpture teleoconch: the first whorls with 4-6 about equally strong spiral ridges with a minutely erose crest; in the later whorls the lowermost developing into a supraperipheral keel, the other 3-5 continuing as much weaker threads, those closest to the periphery strongest but otherwise spread regularly from keel to suture; below this keel 3—6 spiral ridges: two distinct in subperipheral and basal position, the subperipheral slightly less protruding than the supraperipheral, 1-2 thin threads above, and 0-3 below the subperipheral. Umbilicus open, 0.4-0.7 mm diam. Aperture subcircular, but with 1-2 slight angles along the palatal side. Peristome double; the inner little reflected, a circular rim with a notch at the level of the suture; the outer moderately widened and reflected, flat, not or hardly widening towards the palatal side, deeply notched near the suture. Height 2-2.9 mm; width (excl. peristome) 2.4-3.3 mm. Apertural height 0.7-1.0 mm, width 0.9-1.1 mm. Periostracum thin, pale grownish, with deciduous, small, semi-elliptic appendages over the spiral keels.

Ecology. – Lowland rainforest on and near limestone bedrock. A leaf litter dweller.

Distribution. – Malaysia, Sarawak, 2nd div.: Tatau River Basin, Bukit Sarang.

Notes. – Smaller than *Japonia hyalina*, and with two conspicuous spiral ridges on the last whorl instead of one. The pristome is also less distinctly protruding.

Opisthoporus Pfeiffer, 1851

Opisthoporus serenae spec. nov. (fig. 6)

Material seen. – Malaysia, Sarawak, 2nd div.: Lower Tatau River valley, Bukit Sarang group (leg. Serena Lee, V 11678/9 paratypes); do., Bukit Anyi, NW. side (V 12787/>10 paratypes, RMNH 109083/holotype); do., Bukit Lebik, ground level (V 12788/9 paratypes); do., Bukit Lebik, sediment deposits c. 40 m above ground level (V 12789/2 paratypes).

Shell. – Shell medium-sized, disc-shaped with a flat upper side but a somewhat pro-

truding apex, whitish to pale brown, with numerous vague to sharply outlined, medium to dark brown zig-zag radial bands. Whorls 4-4 5/8, convex. Suture impressed. Sculpture protoconch: surface minutely rugulose. Sculpture teleoconch: irregularly spaced growth lines, locally grading into inconspicuous, more or less regularly spaced, low radial riblets, spiral sculpture virtually absent except for, in some shells, a few traces of spiral grooves on the first part of the teloconch Umbilicus wide, 0.33-0.40 x the shell diam. A retrorse tubule is present near the suture, about 1/8 whorl before the aperutre; beyond this the last whorl descends slightly towards the aperture. Aperture circular. Peristome double; the inner not reflected, a thin circular rim with a slight notch at the level of the suture; the outer widened and reflected, narrow on the columellar side, widening towards the palatal side and flaring and with a rather distinct, downward fold on the upper palatal side, creating a channel in between the fold and the suture. Height 6.1-8.8 mm; width (excl. peristome) 13.3-18.0 mm. Height and width aperture 4.4-5.7 mm. Periostracum pale brownish, minutely wrinkly, over the radial riblets with low crests with an edge with short, deciduous hairs, slightly above the periphery these are much longer, together forming a spiral band of hair around the shell. Operculum calcareous, flat, edges of whorls not raised.

Ecology. – Lowland rainforest on and near limestone bedrock. A leaf litter dweller, found near rock outcrops.

Distribution. – Malaysia, Sarawak, 2nd div.: Tatau River Basin, Bukit Sarang.

Notes. – On Borneo, two more *Opisthoporus* occur with a similarly shaped, retrorse tubule. *Opisthoporus biciliatus* (Mousson, 1849) differs in having a second, subperipheral row of hairs, in having fine and regularly spaced spiral grooves on the first part of the teleoconch. *Opisthoporus latistrigus* (von Martens, 1864), differs in being smaller (diam. 9-13 mm), and not having any hairs around the periphery. In both species the fold in the outer peristome, on the palatal side and close to the suture, is (almost) lacking. The peripheral hairs seem to provide the easiest distinguishing character but, unfortunately, they are deciduous and may fall off even in living adult specimens.

Family Hydrocenidae Troschel, 1856

Georissa Blanford, 1864

Note. – The Borneo species were revised by Thompson & Dance (1983).

Georissa pachysoma spec. nov. (fig. 7)

Material seen. – Malaysia, Sarawak, 2nd div.: Lower Tatau River valley, Bukit Sarang group (leg. Serena Lee, V12628/>10 paratypes, RMNH 109084/holotype); do., Bukit Lebik, ground level (V 12837/2).

Shell. – Shell minute, conical with about flat sides and a rounded apex (juveniles ovoid), opaque, orange red turning to off white, somewhat shiny. Whorls up to 3 1/8, convex, the last rounded at the periphery but less so above and below. Suture deeply impressed, bordered by a narrow shoulder. Protoconch about smooth. Radial sculpture teleoconch: growth lines, with (groups of) more distinct ones at irregular intervals. Spiral sculpture teleoconch: the first whorl with 8-12 well-spaced, thin, low spiral threads, in some shells disappearing around the start of the second whorl, in others only disappearing 1/2 whorl before the aperture. Umbilicus closed and covered by the columellar peristome. Aperture about semi-elliptic. Peristome simple, on the columellar side widened and flattened to a callus bordered by a thin, low, erect ridge towards the parietal side, on the

basal and palatal side not thickened nor reflected. Height up to 1.9—2 mm; width up to 1.4-1.6 mm. Apertural height 0.6-0.7 mm, width 0.7-0.8 mm.

Ecology. – Lowland rainforest on and near limestone bedrock. On mossy rock faces.

Distribution. – Malaysia, Sarawak, 2nd div.: Tatau River Basin, Bukit Sarang.

Notes. – Among Bornean *Georissa*, *G. gomantongensis* is most similar. It differs in having a lemon yellow shell, a somewhat larger aperture at the same size (c. 1 mm across), and spiral sculpture all over the shell, down to the aperture.

Family Ariophantidae Godwin-Austen, 1888

Medyla Albers, 1860

Medyla decrespignyi (Higgins, 1868) (fig. 8)

Nanina (Xesta) de-crespignii Higgins, 1868: 179; holotype ("Labuan") leg. De Crespigny (not seen).

Material seen. – Malaysia, Sarawak, 2nd div.: Lower Tatau River valley, Bukit Sarang group (leg. Serena Lee, V 11996/4); do., Bukit Anyi, NW. side (V 12874/6); do., Bukit Anyi, SE. side (V12875/2); do., Bukit Lebik, ground level (V 12876/7); Upper Tatau River valley, upper Kakus River limestone scarps (leg. K.F. Leong, V 12881/1).

Ecology. – Lowland rainforest on and near limestone bedrock. Active at night, creeping on the forest floor and on vegetation.

Distribution. – Malaysia, Sarawak, 2nd div.: Tatau River Basin, Bukit Sarang, Ulu Kakus. 5th div.: Trusan River valley (1891). Sabah: Labuan (1868).

Notes. – So far only known from old records. The Labuan population is presumably extinct; the Trusan Valley has not been explored malacologically in recent years. The species seems absent from well-explored limestone areas further to the West: Niah Caves N.P., and Gunung Mulu N.P. The new records in the Tatau River basin show that the species occurs in highly localized populations, apparently on and near limestone hills.

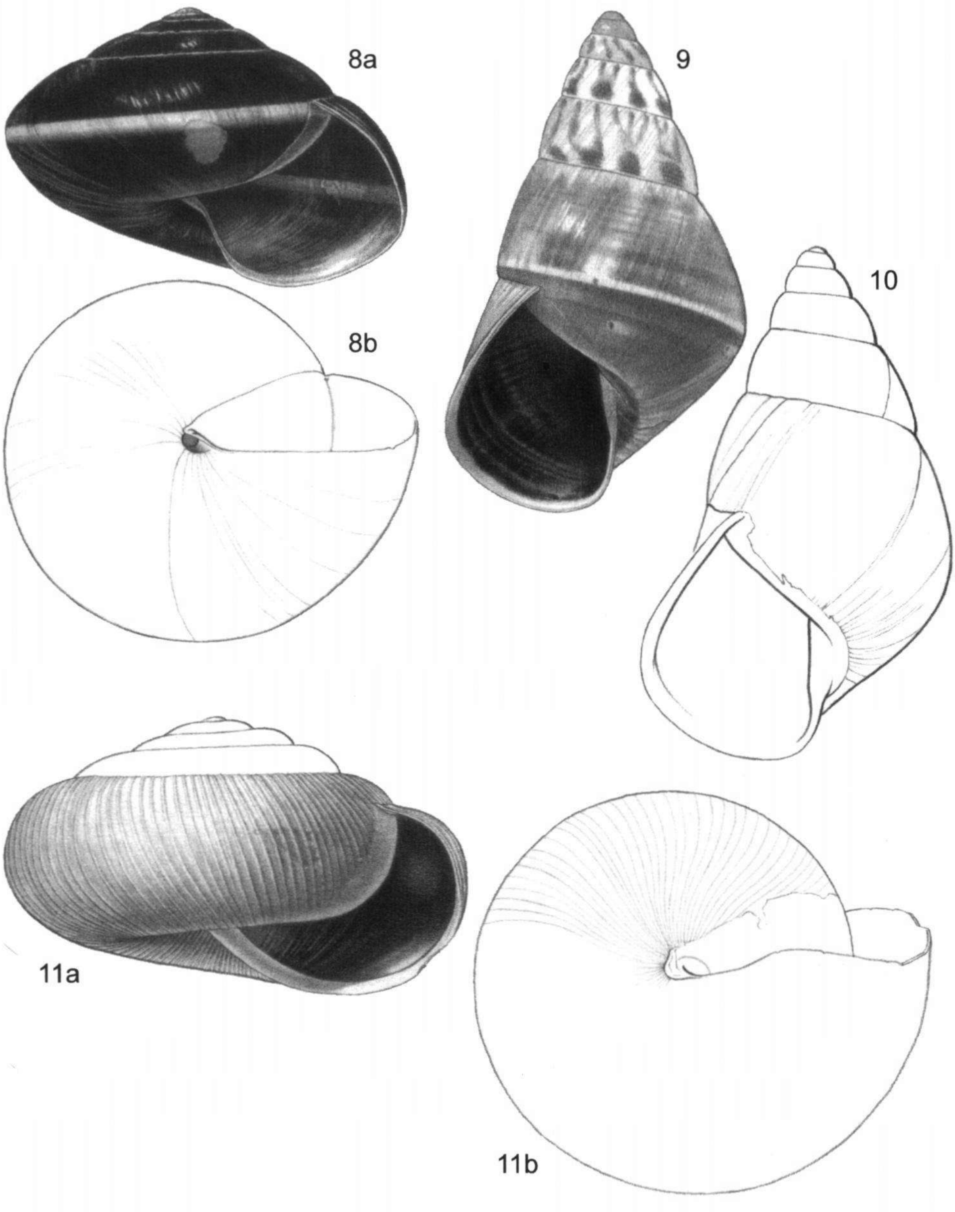
Family Camaenidae Pilsbry, 1894

Amphidromus Albers, 1850

Amphidromus thalassochromus spec. nov. (fig. 9)

Material seen. – Malaysia, Sarawak, 2nd div., Lower Tatau River valley, Bukit Sarang group (leg. Serena Lee, V 120072/2 paratypes); do., Bukit Anyi, NW. side (V12898/>10 paratypes, RMNH 109085/holotype); do., Bukit Anyi, SE. side (V 12899/1 paratype); do., Bukit Lebik, ground level (V 12900/3 paratypes.

Shell. – Shell large, sinistral, conical with flat sides, top whorls with creamy white to pale brownish ground colour, with yellowish green, bleuish purple or brownish purple radial colour bands that bifurcate in the upper half of the whorls, ground colour grading to pale blueish green to purplish brown on the last worls, with a pale yellow or whitish peripheral band, above the periphery often with a few radial colour bands of irregular outline of the same colour, below the periphery often with a few scattered tiny dark spots



Figs 8-11. *Medyla, Amphidromus* and *Teracharopa* spec. **8. a,** *Medyla decrespignyi* (Higgins), Malaysia, Sarawak, Bukit Sarang (V, shell height 17 mm), frontal view; **b,** do., umbilical view. **9.** *Amphidromus thalassochromus* spec. nov., holotype, Malaysia, Sarawak, Bukit Sarang (RMNH, shell height 32 mm), frontal view. **10.** *Amphidromus coeruleus* Clench & Archer, Malaysia, Sarawak, Batu Niah National Park (V, shell height 33 mm), frontal view. **11. a,** *Teracharopa lenticula* spec. nov., holotype, Malaysia, Sarawak, Bukit Sarang (RMNH, shell height 2.3 mm), frontal view; **b,** do., umbilical view.

with a yellow halo, sometimes (always in juveniles) with a yellow spiral band, umbilical region often with a darker purplish brown patch, peristome white, aperture inside dark brown; shell opaque, shiny. Whorls 6 1/8-7, slightly convex, the last obtusely angular at the periphery, slightly convex above and below. Suture somewhat impressed. Sculpture protoconch: surface minutely punctate. Radial sculpture teleoconch: fine growth lines only. Spiral sculpture teleoconch: traces of a very fine, irregular striation (visible at 40 x magn.). Umbilicus closed and covered by the columellar peristome. Aperture obliquely truncated ovate. Peristome simple, narrowly reflected, not or hardly thickened, abruptly widened in the umbilical region, a thin glaxing on the parietal side. Height 31-40 mm; width (excl. peristome) 18-21 mm. Apertural height 12-17 mm, width 10-12 mm.

Ecology. – Lowland rainforest on and near limestone bedrock.

Distribution. – Malaysia, Sarawak, 2nd div.: Tatau River Basin, Bukit Sarang.

Notes. – Most similar to *A. angulatus* Fulton, 1896, and *A. coeruleus* Clench & Archer, 1932 (see fig. 10). It agrees well with both species in shape and colour pattern, but it differs by the obtusely angular periphery, down to the peristome, in fully adult shells. Juveniles are obtusely angular in all three species; these cannot be distinguished. *A. angulatus* has been described as 'more or less sharply angular at the periphery'; the illustration, however, shows a shell well rounded at the periphery. Available material (no type material) shows that the shells are indeed slightly angular around the attachment of the peristome, but this fades out quickly on the last whorl, so that the peripheral profile of adult shells in frontal view is well rounded.

Present collections seem to indicate that only *A. thalassochromus* occurs on and around Bukit Sarang; from the nearest limestone ranges in the Ulu Kakus *A. coeruleus* has been recorded.

Family Charopidae Hutton, 1884

Teracharopa Maassen, 2000

Teracharopa lenticula spec. nov. (fig. 11)

Material seen. – Malaysia, Sarawak, 2nd div.: Lower Tatau River valley, Bukit Sarang group (leg. Serena Lee, V 12472/2 paratypes); do., Bukit Anyi, NW. side (V 12918/>10 paratypes, RMNH 109086/holotype); do., Bukit Anyi, SE. side (V 12919/10 paratypes); do., Bukit Lebik, ground level (V 12920/9 paratypes); do., Bukit Lebik, sediment deposits c. 40 m above ground level (V 12921/1 paratype).

Shell. – Shell very small, lenticular with slightly raised spire, white, slightly translucent, with a silky lustre. Whorls up to 5, slightly convex; the last usually slightly shouldered just below the suture (more distinctly so in juveniles). Suture little impressed. Sculpture protoconch: seemingly smooth, but minutely rugulose, just visible at 40 x magn. Radial sculpture teleoconch: a few inconspicuous growth lines, also with low and flat, rather densely placed (near the apex) to rather well spaced ribs at more or less regular intervals, on the last whorl running from the suture to the umbilicus; shell surface in between the ribs minutely rugulose above the periphery, much less so below. Umbilicus closed and covered by the columellar peristome. Aperture lunulate. Peristome simple; somewhat reflected on the columellar side, not thickened nor reflected on the basal and palatal side, a thin glazing on the parietal side. Height up to 2.5 mm; width up to 4 mm. Apertural height up to 1.6 mm, width up to 2.2 mm.

Ecology. – Lowland rainforest on limestone bedrock.

Distribution. – Malaysia, Sarawak, 2nd div.: Tatau River Basin, Bukit Sarang.

Notes. – Differs from the two known species of the genus, *T. goudi* Maassen, 2000, and *T. rara* Maassen, 2000, both from Sumatra, in having a flatter shell, with a lower spire, as well as in lacking both spiral sculpture as well as the microscopically rugulate sculpture. The genus differs from *Pilsbrycharopa* Solem, 1978, in having a protoconch without any riblets.

ACKNOWLEDGEMENTS

The field work necessary for this report was entirely sponsored by Grand Perfect Sdn Bhd, Conservation Department, Bintulu, the land management authority for the area. The first author's former employer, Singapore Botanic Gardens, was so kind as to regard snails as a sort of honorary members of the orchid family, thus enabling him to conduct this survey in office time.

REFERENCES

DANCE, S.P., 1970. Non-marine molluscs of Borneo. I. Streptaxacea: Streptaxidae. – Journal of Conchology 27: 149-162.

HARRISON, T., & REAVIS, J.L., 1966. The Sarang caves in Sarawak. – Sarawak Museum Journal 14: 249-268.

THOMPSON, F.G., & DANCE, S.P., 1983. Non-marine mollusks of Borneo II Pulmonata: Pupillidae, Clausiliidae III Prosobranchia: Hydrocenidae Helicinidae. – Bulletin of the Florida State Museum 29: 101-152.

VERMEULEN, J.J., 1993. Notes on the non-marine molluscs of the island of Borneo 5. The genus *Diplommatina* (Gastropoda Prosobranchia: Diplommatinidae). – Basteria 57: 3-69.

VERMEULEN, J.J., 1994. Notes on the non-marine molluscs of the island of Borneo 6. The genus *Opisthostoma* (Gastropoda Prosobranchia: Diplommatinidae), part 2. – Basteria 58: 73-191.

VERMEULEN, J.J., 2003. The terrestrial mollusk fauna of Batu Niah N.P. and Gunung Mulu N.P., Sarawak, Malaysia. – Internal report for the SWMPI-project of DANIDA. Singapore.

VERMEULEN, J.J., 2005. Mollusk biodiversity of the Sangkulirang Peninsula, Kalimantan Timur, Indonesia. – Internal report for TNC-Indonesia. Singapore.

VERMEULEN, J.J., 2007. Notes on the non-marine molluscs of Borneo 10. The genera *Bruggennea*, *Gulella* and *Sinoennea* (Gastropoda Pulmonata: Streptaxidae). – Basteria 71: 169-176.

WILFORD, G.E., 1956. Limestone in British Borneo. – Annual Report Geol. Survey Dept. for 1955: 41–66.